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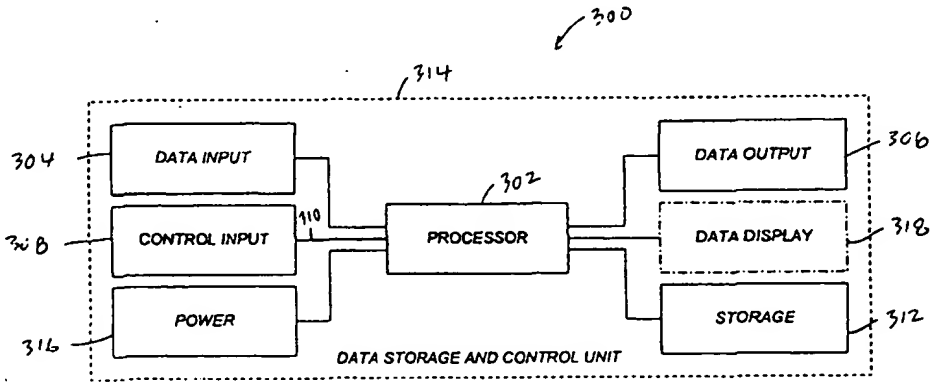

(57) Abstract

A data storage and control unit has processor connected to a data input for receiving data, a data output for providing data, a control input for providing a control signal, and a storage device for storing data. The processor causes data received at the data input to be stored on the storage device and causes data stored on the storage device to be provided to the data output upon receipt of the control signal from the control input. The data storage and control unit may be configured as: a portable presentation unit for presenting data such as photographs, graphics, and text; a portable photo storage unit for storing digital photographs either directly from a digital camera or from another source; or an audio/video (A/V) play-back unit for playing a series of photographs onto a conventional display such as a television. The data storage and control unit may include any combination of data inputs and outputs to enhance the versatility of the unit, such as memory card ports, data ports, video ports, and wireless ports. The storage devices may include memory chips and/or hard drives.

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PORTABLE STORAGE AND CONTROL UNITS FOR DIGITAL DATA

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to apparatus for managing digital data. More particularly, the present invention relates to devices for receiving, storing, and controlling data, particularly digital images.

Description of the Related Art

The field of digital photography is expanding at a rapid pace. Once the exclusive appliance of professional photographers and artists, digital cameras are now utilized by all levels of photographers. This widespread use is the result of the consistent drop in price of digital cameras, which is now on the level of a few hundreds of dollars, or about the same price as a conventional 35mm camera.

One of the advantages of digital cameras is that there is no film to process. Rather, the images are in the form of digital data stored on memory cards. The digital data stored on the memory cards may be downloaded onto a computer for viewing or enhanced processing. One of the drawbacks of memory cards is the price, which may be on the order of about 20 percent the total price of the camera. Another drawback is storage capacity. With the increased resolution of digital cameras, the resultant images have a large amount of data. Accordingly, only a small number of images may be stored on a single memory card. If a large number of pictures are to be taken at a remote location, a photographer needs to carry to the location a large number of memory cards, which is expensive, or a laptop computer, which is inconvenient.

Another drawback of digital images is the limited display alternatives. Typically, the digital photographs are displayed with a computer on the monitor connected to the computer. The images may then be printed out on a color printer. Although the price has dropped significantly over the past decade, personal computers are still relatively expensive, as are color printers. In addition, most personal computers are at work or in a home office, both of which are not convenient locations to view photographs.

Conventionally, film pictures are displayed in picture frames, with the frame sitting on a

desk top or a bookshelf or hung from a wall. A picture frame may display a single picture or more than one picture by using matting with multiple openings. When using matting with more than one opening, the pictures usually need to be cut manually to fit within the openings. In order to display many pictures, multiple picture frames need to be used. Digital images are only able to be displayed in conventional picture frames if they are printed out on a laser printer.

One of the drawbacks of a conventionally processed and printed picture displayed in a picture frame does not change in appearance. In other words, conventional pictures are static. To change the picture, the frame needs to be disassembled, which usually involves removing clips from the back of the frame. The picture is then removed and replaced with a new picture. The frame is then reassembled.

In addition to being displayed in frames, pictures are displayed in photo albums. Photo albums are particularly useful in displaying a plurality of images. Typically, a small number of pictures are retained on each page of an album. The pages are turned to view the pictures. Photo albums are limited in the number of pictures that may be displayed. Often times, photo albums are in the form of three-ring binders, which become increasingly bulky as additional pages are added.

Overall, conventional picture frames and photo albums are limited in the number of pictures which may be displayed and in the way the pictures are displayed. In addition, with digital cameras becoming increasingly popular, consumers, who are less reliant on picture frames and photo albums to display pictures, are looking for enhanced approaches to display their digital pictures.

Turning attention again to the display of digital images, conventional personal computers (PCs) display images in digital format. The images are stored as digital data on a hard drive, and a central processing unit (CPU) displays the digital data on a monitor. Many users digitize photographs through the use of scanners and then edit and display the digitized images on the monitor of the computer. Alternatively, photographs taken on a digital camera are already in digital format. If desired, a user can display an image on a monitor in full-screen format (that is, with no other window visible). However, in order to run other applications conveniently on the computer without utilizing windows of reduced size, the display of the image in full-screen format needs to be terminated. Accordingly, it is not convenient to utilize conventional computers for the long-term display of images.

As known, conventional computers include a housing for the circuitry, a keyboard, and a

monitor. Desk-top computers typically use cathode ray tubes (CRTs) as monitors, while portable computers typically use liquid crystal displays (LCDs). Although the cost of computers has fallen, desk-top models still cost on the order $1,000, while portable computers are at least double that figure. The price of convention computers is at that level because of the sophistication of the circuitry and the CPU to run increasingly complex applications. Accordingly, it is not cost effective to use a computer for the sole purpose of displaying images for viewing.

In view of the foregoing, there remains a need in the art for devices that are able to receive and manage data economically, conveniently, and according to enhanced techniques.

BRIEF SUMMARY OF THE INVENTION

A data storage and control unit of the present invention has processor for controlling the operation of the unit and a number of elements connected to the processor, including a data input for receiving data, a data output for providing data, a control input for providing a control signal, and a storage device for storing data. In accordance with the present invention, the processor is configured to cause data received at the data input to be stored on the storage device and to cause data stored on the storage device to be provided to the data output upon receipt of the control signal from the control input.

The data storage and control unit of the present invention may be configured according to a number of exemplary commercial embodiments. For example, the data storage and control unit may be configured as a portable presentation device for presenting data such as photographs, graphics, and text. The portable presentation device of the invention eliminates the need to utilize a conventional laptop computer to present information.

Alternatively, the data storage and control unit may be configured as a portable photo storage unit for storing digital photographs either directly from a digital camera or from another medium or media. The portable photo storage unit eliminates the need to carry a large number of memory cards to remote locations for storing digital photographs, which memory cards are expensive. In addition, the portable storage unit also eliminates the need for a photographer to carry a conventional laptop computer to a remote location for storing digital photographs. Indeed, the storage unit of the invention may be sized to be carried in a shirt pocket or with a belt clip.

Further, the data storage and control unit may be configured as an audio/video (A/V) play-

back unit for playing at least one but preferably a series of photographs onto a conventional display such as a television or monitor. The play-back unit of the invention has a video output that is compatible with conventional video formats. Accordingly, the play-back unit may be utilized with any type of (A/V) display, particularly televisions. This feature enables the play-back unit to function analogously with, but without the inconvenient drawbacks of, a conventional slide projector.

According to one aspect of the invention, a portable data storage and control unit includes a housing in which the processor and the storage device are received. Each of the inputs and the output may be disposed on the housing in an accessible manner. In accordance with the portable nature of a number of exemplary embodiments of the invention, the housing has dimensions that render the data storage and control unit portable and easy to carry on person. For example, in a photo-storage embodiment of the invention, the housing may be dimensions of less than about 6 inches by 3 inches by 2 inches, rendering a volume of less than about 40 cubic inches.

According to another aspect of the invention, the portable data storage and control unit further includes a power supply connected to the processor. In keeping with the preferred portable nature of the invention, the power supply preferably includes a battery, either rechargeable or replaceable. Alternatively, the power supply may include a power input such as a DC adapter input or an AC adapter input. A switch may be provided for activating the power supply. The portable data storage and control unit may include a data display for providing information, either textual or visual, indicative of the data stored on the unit.

The storage device of the portable data storage and control unit storage device may be a memory or a hard drive, or both. The data input may including any one or any combination of a memory card port for receiving memory cards, a data port for connecting with a communication medium, a wireless input for receiving data transmitted via radio frequency, and a video port for connecting with a conventional video cable. The control input may include a manual input such as navigation buttons or a remote input for receiving the control signal from a remote control.

Other aspects, features, and advantages of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a perspective view of a digital image display in accordance with an exemplary picture-frame embodiment of the present invention, particularly illustrating the front of the picture frame;

FIG. 2 is a perspective view of the digital picture frame of FIG. 1, particularly illustrating the back of the frame;

FIG. 3 is a block diagram of a digital image display in accordance with an exemplary embodiment of the present invention;

FIG. 4 is a block diagram of a plurality of digital image displays cascaded in accordance with the present invention;

FIG. 5 is a block diagram of a digital image display in accordance with another exemplary embodiment of the invention, particularly illustrating a cascadable image display;

FIG. 6 is a perspective view of a digital image display in accordance with an exemplary photo-album embodiment of the present invention;

FIG. 7 is a schematic view of an exemplary data storage and control unit in accordance with the present invention;

FIG. 8 is a more detailed schematic view of the data storage and control unit of FIG. 7;

FIG. 9 is a perspective view of an exemplary data storage and control unit of the present invention configured as a portable presentation unit, particularly illustrating a front of the unit;

FIG. 10 is a perspective view similar to that of FIG. 9, particularly illustrating a back of the unit shown partially cut away;

FIG. 11 is a schematic view of an exemplary data storage and control unit connected to a remote data destination device such as an audio/visual device in accordance with the present invention;

FIG. 12 is a plan view of a remote control device for use with the data storage and control unit of the present invention;

FIG. 13 is a perspective view of another exemplary data storage and control unit of the present invention configured as a play-back unit, particularly illustrating a front of the unit;

FIG. 14 is a perspective view similar to that of FIG. 13, particularly illustrating a back of the unit shown partially cut away;

FIG. 15 is a perspective view of an exemplary data storage and control unit of the present invention configured as a portable storage unit, particularly illustrating a front of the unit;

FIG. 16 is a perspective view similar to that of FIG. 15, particularly illustrating a back of the unit shown partially cut away; and

FIG. 17 is a schematic view of an exemplary data storage and control unit connected to a remote data origination device such as a digital camera in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides apparatus and associated methodology for storing data, for example, digitized photographs, for managing such data, and for displaying such data in a desirable and enhanced manner. The description of the present invention hereunder is divided generally into two sections. The first section is directed to exemplary embodiments of digital image displays, and the second section is directed to data storage and control units.

DIGITAL IMAGE DISPLAYS

Digital Picture Frame

Referring more particularly to the drawings, an exemplary digital image display **100** configured in accordance with the teachings of the present invention is illustrated in FIGS. **1** and **2**. For purposes of explanation and without limiting the scope of the present invention, exemplary image display **100** is illustrated as digital picture frame. However, as discussed in more detail below, the principles of the present invention may also be applied to, for example, digital photo albums and other video display devices.

The digital picture frame **100** generally includes a housing **102**, a frame **104**, and a display device **106** such as a liquid crystal display (LCD). In a preferred embodiment, display circuitry **108** is mounted, for example, on a circuit board **110** which is disposed within the housing **102**. Other embodiments of the present invention dispose the display circuitry **108** external to the housing and the picture frame **100**, which will be discussed in detail below.

Exemplary display circuitry **108** may include a processor **112** and memory **114**. The memory **114**, which may include both volatile and nonvolatile memory, stores an image in the form of image data. The processor **112** reads the data stored in the memory **114** and displays the image

on the display device **106**. Preferably, the memory **114** stores a plurality of images with the processor **112** periodically reading and displaying images in succession. Accordingly, exemplary digital image display **100** of the present invention may provide either a single image in picture-frame fashion or a number of images in slide-show fashion. Depending upon the size of the memory **114**, hundreds of images may be stored for display on the display device **106**. The memory **114** may be in the form of, for example, DRAM, SRAM, SLDRAM, RDRAM, DR-DRAM, flash, etc.

Accordingly, by configuring the digital picture frame **100** of the present invention with only the housing **102** with the frame **104**, the display device **106**, and the display circuitry **108**, the picture frame may be economically manufactured, possibly on the order of tens of dollars. Accordingly, the picture frame **100** of the present invention is within the economic reach of a large market. In addition, as the picture frame **100** does not need to run complex software applications but rather has the function of displaying images, the processor **112** may be relatively inexpensive processor (for example, an x86 processor). As the processor is typically one of the major costs of manufacturing conventional computers, this feature of the present invention significantly reduces the cost of producing the picture frame **100**.

In addition, the processor **112** may begin a count when sending the image data to the display device **106**. After a predetermined amount of time, the processor **112** may read the next set of image data from the memory **114** and send this subsequent image to the display device **106**. The processor **112** may also process a transition effect when changing images displayed on the display device **106**. For example, the image currently displayed on the display device **106** may fade out while the next image to be displayed comes into view.

An exemplary embodiment of the display circuitry **108** is illustrated in FIG. **3**. As discussed above, a representative embodiment of the display circuitry **108** includes the processor **112** and the memory **114**. The processor **112** reads image data **116a** stored on the memory **114** for one or more images to be output to the display **106**.

In addition to data stored locally in the memory **114**, the processor **112** may receive image data **116b** from a remote source **118** via a data port **120**. While shown schematically in FIG. **3**, the data port **120** may be an industry-standard connector as shown in FIG. **2** for connecting to a complementary cable **122**. The remote source **118** may be a computer or an Internet site, for example. Alternatively, the remote source **118** may be another image display of the present

invention, which will be discussed in more detail below. The remote image data **116b** are downloaded by the processor **112** and stored in the memory **114** and/or transmitted to the display **106**. The processor **112** may receive remote image data **116b** passively from the remote source **118** or may send a signal to the remote source **118** to initiate the transmission of the image data. The data port **120** may be an RJ-xx jack for coupling with conventional telephone or network lines. Alternatively, the data port **120** may be an infrared sensor so that the image display **100** may receive image data wirelessly. Alternative embodiments of the invention utilizing wireless communication of data are discussed below.

For the purposes of this description, image data output to the display **106** are generally referenced by numeral **116**. Image data received from difference sources are specifically referenced with the addition of an alpha suffix. For example, image data stored on the memory are indicated by **116a**, while image data received via data port **120** are indicated by **116b**.

According to another embodiment of the invention, the display circuitry **108** may include a memory card port **124** with a controller **126**. The memory card port **124** is configured to receive a portable memory card **128** as shown in FIG. **2**. For example, port **124** may be configured to receive Type II ATA cards or other cards available on the market as CompactFlash™, SmartMedia™, MiniatureCard™, and so on. Alternatively, the memory card port **124** may be a drive configured to receive a floppy disc, compact disc read-only memory (CD-ROM), or other conventional magnetic or optical storage media. The controller **126** downloads and provides image data **116c** to the processor **112**. Image data **116c** may be read by the processor **112** from the memory card port **124** as needed to display images or may be stored in the memory **114** to be read for display at some time in the future. In addition to the various memory cards mentioned above, the portable memory card **128** may be a memory card as utilized in the field of digital photography, which will be discussed in detail below.

Yet another embodiment of the display circuitry **108** of the invention includes a video port **130** with a video controller **132**. The video port **130** may be configured as a standard video connector for receiving a complementary video cable **134** as shown in FIG. **2**. Analogous to that of image data **116b** and **116c** respectively received at ports **120** and **124**, image data **116d** received via the video port **130** are decoded by the decoder **132**, received by the processor **112** for output to the display **106**, and/or stored in the memory **114**. In contrast to data for single images, the video image

data **116c** output to the display **106** may be in the form of continuous motion video, rather than single images.

As mentioned above, the remote source **118** of image data **116b** may be another image display **100**. More specifically, the display circuitry **108** may include an expansion port **136** which enables two of the image displays **100** of the invention to be cascaded or connected in series, which is shown in FIG. **4**. To cascade a plurality of image displays **100a–100*n***, the expansion port **136a** of a first image display **100a** may be connected to the data port **120b** of a second image display **100b** of the invention. The expansion port **136b** of the second image display **100b** may in turn be connected to the data port **120c** of a third image display **100c**, and so on. Accordingly, a preceding image display **100** may act or serve as a remote source of image data **116b** for a subsequent image display **100**. The processor **112** of a first of the image displays **100** may function as a master processor to control the subsequently connected image displays. The same image or a different image may be displayed on each image display **100**.

Alternatively, each of the cascaded image displays **100** may have image data for a plurality of images stored in memory **114**. One of the image displays **100** in the cascade (for example, the first image display **100a**) may serve as a master display which sends a synchronization pulse to the subsequent image displays **100b**, **100c**, ... **100*n*** via the expansion port **136**. Upon receiving the synch pulse, the subsequent image displays **100** may switch from one displayed image to another displayed image. The master display may send a synch pulse periodically so that the plurality of image displays **100** switch from one image to another. This cascaded embodiment of the invention has particular utility in, for example, public displays or advertising.

Yet another embodiment of the cascadable image display of the invention is shown in FIG. **5**, wherein the image display **100** may include a plurality of data ports **120a**$_1$, **120a**$_2$, ... **120a**$_i$. A first data port **120a**$_1$ of a first image display **100a** in the cascade of displays may be connected to a remote source **118** to receive image data as described above. The expansion port **136a** of the first image display **100a** may be connected to one of the data ports **120b** (e.g., a second data port **120b**$_2$) of a second image display **100b** in the cascade. Another one of the data ports **120b** of the second image display **100b** (e.g., a first data port **120b**$_1$) may be connected to a remote source **118** (which may be the same remote source as that connected to the data port **120a**$_1$ of the first image display **100a** or another remote source of image data). Accordingly, the second image display **100b** (and

additional subsequent image displays) may receive a synch pulse via the data port **120** connected to the expansion port **136** of a preceding image display, while receiving image data from a remote source **118** via another one of the data ports **120**.

With further reference to FIGS. **1** and **3**, in addition to the visual output or display **106**, the digital picture frame **100** may include an audio output or speaker **138**. Audio data may be received by the processor **112** and output to the speaker **138** in a manner analogous to that of the image data **116** described above. In addition, the video image data **116c** may include audio data decoded by decoder **132**, with the processor **112** outputting the visual component of the video data **116d** to the display **106** and the audio component of the video data **116d** to the speaker **138**. Alternatively, the image display **100** of the present invention may include a dedicated audio CD drive and controller (not shown) for playing audio compact discs (CDs) via the speaker **138**. In this regard, a plurality of speakers **138** may be provided. Furthermore, in an embodiment in which the memory card port **124** is configured as a CD-ROM or a DVD drive, audio data stored on a CD-ROM or a DVD received in port **124** may be read by the processor **112** and output to the speaker **138**.

With continued reference to FIGS. **1** and **3**, the digital picture frame **100** may include an optical sensor **140** for receiving and measuring the level of ambient light. In operation, the optical sensor **140** provides a signal **142** to the processor **112** which, in turn, provides an adjust signal **144** to the display **106** to modify the manner in which the image data **116** are displayed. For example, if the digital picture frame of the invention is positioned in a room with windows, then the ambient light changes throughout the course of the day, from darker to brighter to darker. The optical sensor **140** measures the ambient light and enables the processor **112** to responsively adjust the brightness of the display **106** accordingly.

In addition to sensing light, the optical sensor **140** may sense motion as well. For example, upon sensing motion, such as when a person enters a room, the optical sensor **140** may send a signal to the processor **112** which, in turns, turns on the picture frame **100**. The processor **112** may be further configured to turn the picture frame **100** off after a predetermined amount of time after receiving the last motion signal from the optical sensor **140**.

In addition to the optical sensor **140** for automatically controlling the display **106**, the digital picture frame **100** may include manually operated display controls **146**. The display controls **146** may include buttons or other devices for controlling, for example, the brightness (which is the level

of light emission from the display 106), luminance, contrast, and chrominance (including hue and saturation). Upon manual manipulation, the display controls 146 provide the processor 112 with a manual signal 148 which, in turn, provides the adjust signal 144 to the display 106.

As shown in FIGS. 1 and 2, the image display 100 of the present invention is configured as a picture frame. In this regard, a stand 150 may be disposed on the housing 102, preferably with a hinge 152. Alternatively, the housing 102 may include a hanger 154 which enables the digital picture frame 100 to be hung on a vertical surface such as a wall or an upright display panel.

Referencing FIG. 3, the digital picture frame 100 may also include a power supply 156 for providing power to the display circuitry 108. The power supply 156 may be in the form of a rechargeable battery pack 158 as shown in FIG. 2 and as known in the art. When low on power, the battery pack 158 may be replaced with a fully charged battery pack or, alternatively, may recharged in place via a charge socket 160. Alternatively, the power supply 156 may be in the form of a DC adapter input 162 or an AC adapter input 164, both of which are known in the art.

In addition to the processor 112 automatically changing from one image to another after a predetermined amount of time, the digital picture frame 100 may include a manually operated switch 166, as shown in FIGS. 1 and 3, for providing a switch signal 168 to the processor 112 upon activation. Upon receiving the switch signal 168, the processor 112 reads the next file of image data from the memory 114 for display on the display device 106. In an alternative embodiment to the switch 166, the display device 106 may be a touch-sensitive display (or "touch" screen) which provides a switch signal 168 to the processor 112 when touched by a user. In this regard, the processor 112 may display a single image on the display until receiving a switch signal 168. Upon receiving such a signal, the processor 112 may commence a preprogrammed slide show of images or may play a video with sound.

Rather than configuring the switch 166 to be activated manually, the switch 166 may be an infrared sensor for receiving an infrared signal from a remote control to change the images. In this embodiment, the image display 100 of the present invention is particularly useful in the presentation of information at meetings (conventionally shown on overhead projections) or in slide shows.

In a commercial embodiment of the digital picture frame 100, the frame 104 may be made from conventional frame material, for example, wood, plastic, glass, or metal. Accordingly, consumer appeal may be enhanced from the fact that the digital picture frame 100 appears much like

conventional picture frames but displays images in the novel and enhanced manner described above. Although any commercial processor may be used, to minimize the production cost of commercial embodiments, the processor **112** may be, for example, a relatively inexpensive StrongARM, x86, 68xxx, or ColdFire processor. In addition to liquid crystal displays, the display device **106** may be, for example, a TFT display or a CRT display. The display device **106** may be of any size, for example, from relatively small one-by-two-inch or three-by-five-inch models to relatively large 17-inch or 19-inch models. In public display embodiments, a plurality of displays **100** may be arranged in a matrix-like panel to display images on the scale of tens of feet.

Digital Picture Frame

Rather than being configured as a picture frame, the image display of the present invention may be configured as a digital photo album **200** as illustrated in FIG. 6. Analogous to the digital picture frame **100** described above, the digital picture album **200** includes a housing **202** with a frame **204** and a display device **206**. The operation of the digital photo album **200** is also substantially analogous to that of the digital picture frame **100** and may include any one or all of the features of the digital picture frame **100** described above. For example, the digital photo album **200** may include a data port **220**, a memory card port **224**, and a video port **230**, from which image data may be received.

As a numbering convention used for this description, elements of the digital photo album **200** analogous to elements of the digital picture frame **100** are indicated with three-digit reference numerals beginning with a "2" rather than a "1"; for example, the data ports are indicated by numerals **120** and **220**, respectively. In addition to the various ports **220**, **224**, and **230**, the digital photo album **200** may incorporate other elements analogous to those of the same name described above, the description of which will not be repeated, including a speaker **238**, an optical sensor **240**, display controls **246**, a rechargeable battery pack **258**, a charge socket **260**, a DC adapter input **262**, an AC adapter input **264**, and a switch **266**.

In contrast to the intended stationary implementation of the digital picture frame **100** described above, the digital photo album **200** is configured for portable use. Accordingly, rather than a stand or a hanger, the digital photo album **200** includes a cover **268** with a front portion **270** pivotally attached along one side of the frame **204**. Accordingly, when not in use, the cover **268**

may be closed to protect the display device **206**. Rather than the stationary nature of the digital picture frame **100**, the digital photo album **200** is portable and easy to carry on person.

DATA STORAGE AND CONTROL UNIT

In addition to the dynamic image display technology described above, the present invention provides apparatus and associated methodology for storing, controlling, and communicating data, particularly data in the form of digitized images such as photographs and graphics. More specifically, a portable data storage and control unit **300** is shown in FIG. 7 and is configured to receive, store, and transmit data.

A data storage and control unit **300** has processor **302** for controlling the operation of the unit and a number of elements connected to the processor, including a data input **304** for receiving data, a data output **306** for providing data, a control input **308** for providing a control signal **310**, and a storage device **312** for storing data. In accordance with the present invention, the processor **302** is configured to cause data received at the data input **302** to be stored on the storage device **312** and to cause data stored on the storage device **312** to be provided to the data output **306** upon receipt of the control signal **310** from the control input **308**. As discussed in detail below, the data storage and control unit **300** of the present invention may be configured according to a number of exemplary embodiments, including but not limited to:

A) a portable presentation unit for presenting data such as photographs, graphics, and text;

B) a portable photo storage unit for storing digital photographs either directly from a digital camera or from another medium or media; and

C) a play-back unit for playing at least one but preferably a series of photographs, which may be accompanied by audio, onto a conventional display such as a television or monitor.

The data storage and control unit **300** includes a housing **314** in which at least the processor **302** and the storage device **312** are received. Each of the inputs **304** and **308** and the output **306** may be disposed on the housing **314** in an accessible manner, which is discussed below. The data storage and control unit **300** may also includes a power supply **316** connected to the processor **302**. In

accordance with the portable nature of a number of embodiments of the invention, the housing **314** preferably has dimensions that render the data storage and control unit **300** portable and easy to carry on person, for example, in hand, by a belt clip, or from a strap. Depending upon the particular embodiment, the data storage and control unit **300** may also include a data display **318** connected to the processor **302** for displaying information concerning the data, either textual or visual information, which is described in detail below.

A more detailed schematic representation of the data storage and control unit **300** is shown in FIG. **8**. The representation of exemplary unit **300** illustrated in FIG. 8 depicts each of the schematic functional blocks **304, 306, 308, 312, 316,** and **318** shown in FIG. 7 as including a plurality of possible elements. The number of elements included in the functional blocks depends upon the particular implementation of the data storage and control unit **300**. Those skilled in the art will appreciate that the functional blocks of the data storage and control unit **300** may include any or all of the possible elements, as well as modifications and variations of each.

More specifically, exemplary data input **304** may include a memory card port **320**. A controller **322** may be connected between the memory card port 320 and the processor **302**. The memory card port **320** is configured to receive portable memory cards, analogous to that described above in relation to FIG. **2**. The controller **322** downloads and provides data to the processor **302**. The data may be image data as described above or another type of data. The data may be read by the processor **302** from a memory card received by the memory card port **320** as needed or may be transmitted to and stored by the storage **312** to be acted upon in the future.

As an alternative to or in addition to the memory card port **320**, the data input **304** may include a data port **324** that is connectable to a communication medium such as an industry-standard cable or connector. The data port **324** receives data from a remote source such as digital camera. Data received by the data port **324** are transmitted by the processor 302 to either the storage **312** or the data output **306**. As described above, the processor 302 may receive data passively from the remote source connected to the data port **324** or may send a signal to the remote source to initiate the transmission of data. A buffer **326** may be connected between the data port 324 and the processor **302** to buffer the received data.

As an alternative to or in addition to ports 320 and 324, exemplary data input **304** may include a wireless input **328** for receiving data transmitted from a remote source with a radio

frequency (RF). As known in the art, data in the form of electromagnetic radiation may be detected and converted to an electrical signal when transmitted within a frequency range of about 10 kHz to about 110 GHz. In certain embodiments of exemplary unit 300, the wireless input **328** may be configured to receive data transmitted at a relatively high frequency (e.g., 2.4 GHz) but at relatively low power. Such a configuration enables the transmission of data up to about 50 feet. This mid-range data transmission configuration of the wireless input 328 is discussed in detail below.

As an alternative to or in addition to ports 320, 324, and 328, exemplary data input **304** may include a video port **332** with a controller **334**. The video port 332 may be configured as a standard video connector for receiving a complementary video cable. Data received via the video port **332** are decoded by the controller **334** and provided to the storage 312 or the data output **306** by the processor **302**. Data received at the video port 332 may be in the form of continuous motion video with audio.

With continued reference to FIG. **8**, exemplary control input 308 may include either a manual input **336** or a remote input **338**, or both. Exemplary manual input **336** may include at least one control button for activation by a user manually to generate the control signal **310**. Alternatively, exemplary manual input **336** may include a plurality of navigation buttons, which are discussed in detail below. Exemplary remote input 338 is configured to be activated by a user wirelessly through the use of a remote control device, which is also discussed in detail below. Regardless of the particular implementation, inputs 336 and 338 are activatable by a user to generate the control signal **310**. For purposes of this description, the control signal generated by the manual input **336** is indicated by reference **310a**, and the control signal generated by the remote input **338** is indicated by reference **310b**.

There are a number of ways to provide power to the data storage and control unit **300** of the present invention. For example, exemplary power supply 316 may include a battery **340**. In view of portability, it is preferable for the battery **340** to be rechargeable and replaceable as known in the art. As an alternative to or in addition to, exemplary power supply 316 may include a DC input **342** or an AC input **344**, or both. The DC input **342** may be configured to engage with a DC adapter for providing power. Likewise, the AC input **344** may be configured to engage with an AC adapter for providing power. Alternatively, in a more stationary embodiment of the data storage and control unit **300**, exemplary AC input **344** may be configured as a standard electrical plug for receiving **120**

volt, 60-cycle power. Exemplary power supply 316 may include a switch 346 for activation by a user to turn power on and off.

Turning to the output portion of the data storage and control unit 300 of the invention, exemplary data output 306 may include a visual port 348, an audio port 350, a wireless port 352, or a video port 354, or any combination thereof. The visual and audio ports 348 and 350 are configured to engage with a respective communication medium to deliver image and audio data, respectively, to remote destinations. Exemplary wireless port 352 is configured to transmit data on a radio frequency to a remove receiver. Exemplary video port 354 is configured to engage with a video cable to deliver video data received at the video port 332 or stored in the storage 312. Each of the ports 348 to 354 of the data output 306 is discussed in detail below.

As mentioned above and as discussed in more detail below, certain exemplary embodiments of the data storage and control unit 300 may incorporate apparatus for displaying information, either textual, graphical, or visual. Accordingly, exemplary data display 318 may include either a text display 356 or an image display 358, or both. Exemplary text display 356 may be an inexpensive LCD panel capable of displaying text corresponding to data being received, stored, or transmitted by the data storage and control unit 300. For example, the text display 356 may provide information on image files currently stored in the storage 312. Exemplary image display 358 may be a small LCD panel capable of displaying image or graphics data corresponding to data being received, stored, or transmitted by the data storage and control unit 300. For example, the image display 358 may display a "thumbnail" image of a photograph stored in the storage 312. Detailed exemplary embodiments of the displays 356 and 358 are described below.

Concerning the storage of data by the data and storage unit 300, the storage 312 may include a memory 360 or a hard drive 362, or both. Exemplary memory 360 may include both volatile and nonvolatile memory and may be in the form of, for example, DRAM, SRAM, SLDRAM, RDRAM, DR-DRAM, flash, and so on. In keeping with the preferable portability of the data storage and control unit 300, the hard drive 362 may be one of the relatively small devices, for example, on the order of a couple inches in breadth, and relatively inexpensive hard drives currently available on the market.

In view of the foregoing description exemplifying the principles of the present invention, a number of preferred embodiments of the data storage and control unit 300 are described below.

Portable Presentation Unit

With continued reference to FIGS. 7 and 8 and addition reference to FIGS. 9 and 10, the data storage and control unit 300 of the invention is illustrated as a portable presentation unit 364. In this embodiment of the portable presentation unit 364, the data storage and control unit 300 is utilized in conjunction with a remote destination device, such as an audio/visual (A/V) device 366 as shown in FIG. 11. Depending upon the type of presentation, the A/V device 366 may be a television, a monitor, an electronic overhead projector, or other analogous device used in the art in presenting information.

Exemplary portable presentation unit 364 includes the housing 314 in which the processor 302 and the memory 360 are received. The processor 302 and the memory 360, which is in the form of an integrated circuit chip, are shown mounted on a circuit board 368. For the data input 304, exemplary presentation unit 364 may include the memory card port 320. The data input 304 may also include the data port 324.

The data output 306 of exemplary presentation unit 364 may include the visual port 348, as well as the video port 354 and the audio port illustrated as left audio output 350a and right audio output 350b. The video port 354 may be configured in accordance with an industry standard, such as National Television Standards Committee (NTSC), super NTSC, the European PAL standard, video home system (VHS), super VHS, Component Video, Digital Video, IEEE 1394, high-definition television (HDTV), video graphics adapter (VGA), and red-green-blue (RGB), etc.

Exemplary presentation unit 364 may include as the power supply 316 the battery 340 which may be activated with the switch 346. In power indicator light 370 may be provided. The battery 340 is preferably rechargeable and may be recharged via a charge socket 372 and activated with the switch 346. The power supply 316 may also include either the DC input 342 or the AC input 344, or both.

Regarding the control input 308 of exemplary presentation unit 364, the manual input 336 may include a plurality of navigation buttons 374, for example, left, right, up, and down. If desired, the remote input 338 may be provided in the form of an infrared (IR) sensor. Accordingly, a remote control device 376 with an infrared transmitter 378 as shown in FIG. 12 may be provided. The remote control device 376 may include navigation buttons 380, a power button 382, and a battery 384.

To use the presentation unit **364** of the invention in making presentations, data to be presented may be either stored on the memory **360** prior to the presentation, stored on a memory card and inserted into the memory card port **320** during the presentation, or downloaded via the data port **324** during the presentation. One of the data outputs 306 of the presentation unit **364** is then connected to the A/V device **364**. To present, the user generates control signals **310** by manipulating either the navigation buttons **374** disposed on the presentation unit **364** itself as the manual input **336** or the navigation buttons **380** disposed on the remote control device **376** as the remote input **338**. The control signals **310** to cause the processor **302** to provide data to the data output **306** connected to the A/V device **366**. The user continues to generate control signals **310** as desired to present new data on the A/V device **366**.

The data provided to the A/V device **366** may be image data, audio data, video data, or data in the form of presentation files such as Show® and PowerPoint®. The processor **302** may be configured to decode various file formats such as Joint Photographic Experts Group (JPEG), Motion Picture Experts Group (MPEG), tagged image file format (TIFF), and portable document format (PDF).

The portable presentation device **364** is particularly beneficial to business travelers who presently need to carry a laptop computer with them to make presentations. Exemplary presentation device **364** eliminates the need of a laptop computer in making presentations. The data needed for the presentation may be stored on the memory **360** at the user's office, and then the presentation device **364** may be carried on the user to the presentation site.

Alternatively, rather than storing data on the memory, the presentation data may be stored on one or more memory cards, with the presentation unit 364 and the memory cards carried to the presentation site. The processor **302** may read the presentation data directly from the memory card received in the memory card port **320** and then write the data directly to the control output **306** connected to the A/V device **366**. In this embodiment, it is not necessary to include a memory on the circuit board **368** of the unit as a virtually unlimited supply of presentation data may be stored on a plurality of easily carried memory cards. Further, the processor 302 does not need to be a high-level processor capable of running complex software applications. Rather, the processor **302** may be relatively simple and capable of only causing data from a memory card received in the memory card port **320** to be provided to the data output **306**. Accordingly, one basic embodiment of the data

storage and control unit of the invention configured as a presentation unit **364** may consist entirely of the processor **302**, the housing **314**, the memory card port **320**, the control input **308**, the battery **340** with the switch **346**, and the visual port **348**. Such an embodiment may be implemented not only inexpensively but also on a small physical scale to enhance portability. The cost and size of the presentation unit **364** are also reduced because there is no need for the inclusion of an on-board display device.

In this regard, it is preferable to minimize the size of exemplary presentation device **364** as much as possible to maximize the portability thereof. Accordingly, in a commercial embodiment of the presentation unit **364**, the housing **314** may have dimensions that render a volume thereof of less than about 40 cubic inches. For example, with particular reference to FIG. **9**, the housing **314** of exemplary presentation unit **300** may have a length (*l*) less than about 5 inches, a height (*h*) less than about 3 inches, and a width (*w*) of less than about 1 inch. Having these exemplary dimensions, the housing **314** has a volume of about 15 cubic inches, enabling the presentation unit **364** to be carried in a shirt pocket.

Play-Back Unit

With continued reference to FIGS. **7** and **8** and addition reference to FIGS. **13** and **14**, the data storage and control unit **300** of the invention is illustrated as a play-back unit **386**. The play-back unit **386** is utilized in conjunction with a remote destination device in a manner analogous to that shown in FIG. **11** with the A/V device **366**. However, rather than being intended to professional presentations, the play-back unit **386** is particularly configured for in-home use. In this manner, the A/V device **366** is preferably a television, although other analogous devices may also be connected to the play-back unit **386** of the invention.

Exemplary play-back unit **386** includes the housing **314** in which the processor **302** and the memory **360** are received. The processor **302** and the memory **360** may be mounted on the circuit board **368** as described above. In addition to a memory chip, the storage **312** of the play-back unit **386** may include a hard disk **362**. For the data input **304**, exemplary play-back unit **386** may include the memory card port **320**, the data port **324**, or the video port **332**, or any combination thereof. The data input **304** may also include an audio input **388**. The data port **324** of the data input **304** may be configured to be compatible with an industry-standard cable, such as IEEE 1394 or small computer

systems interface (SCSI), or may be a serial or a parallel cable, such as those used with printers.

The data output 306 of exemplary play-back unit 386 may include only the video port 354. The audio port 350 may also be included. As shown in FIG. 14, the data output 354 may include a plurality of video ports 354a, 354b, 354c. Each of the video ports may be configured to a respective an industry standard, such as NTSC, PAL, and VHS mentioned above.

Rather than a battery utilized in portable embodiments of the invention, the power supply 316 of exemplary play-back unit 386 may include the AC input 344 in the form of a standard power cord 390. The switch 346 and the indicator light 370 may also be provided.

Substantially analogous to the presentation unit 368 described above, the manual input 336 of exemplary play-back unit 386 may include a plurality of navigation buttons 374. Also, the remote input 338 may be provided in the form of an infrared (IR) sensor for use with a remote control device 376 as shown in FIG. 12.

To use the play-back unit 386 of the invention, data to be presented may be either stored on the memory 360 or on the hard disk 362 prior to the presentation, stored on a memory card and inserted into the memory card port 320 during the presentation, or downloaded via the data port 324 or the video port 332 of the data input 304 during the presentation. One of the video ports 350 of the data output 306 is connected to an A/V device such as a television. The user then generates control signals 310 by manipulating either the navigation buttons 374 disposed on the play-back unit 386 itself as the manual input 336 or the navigation buttons 380 disposed on the remote control device 376 as the remote input 338. The control signals 310 to cause the processor 302 to provide data to the video port 350 connected to the A/V device 366. The user continues to generate control signals 310 as desired to present new data on the A/V device 366.

As the play-back unit 386 is primarily intended for in-home use, the data controlled by the unit is preferably digitized images in the form of image data. For example, a user can store a plurality of digitized photographs stored on a memory card and then show the pictures on his or her own television in a slide-show fashion. The provision of the hard drive 362 allows a large amount of data to be stored by the unit, thereby reducing the need to utilize a plurality of memory cards when presenting a large number of photographs. Alternatively, the data input 304 of exemplary play-back unit 386 may include a plurality of memory card ports 320 each capable of receiving a memory card simultaneously.

The play-back unit **386** may be easily integrated into existing home-theater systems with the use of the video port **332** of the data input **304**. For example, the cable connected to the video output of an existing video cassette recorder (VCR) may be connected to the video port **332** of the data input **304**, and one of the video ports **350** of the data output **306** may then, in turn, be connected to the television. Accordingly, exemplary play-back unit 386 enables the pass through of video data. In this regard, the housing **314** of exemplary play-back unit 386 may be configured to be size compatible with industry standards for home-theater electronic appliances. Alternatively, the play-back unit **386** may be a relatively small appliance positioned on a coffee table near the user for easy manipulation, for example, replacing memory cards in the memory card port **320**. In any case, the play-back unit **386** of the present invention essentially converts an existing television into a digital photo album analogous to that described above. In addition, the play-back unit **386** essentially functions as a digital slide projector in conjunction with an existing television, rendering obsolete traditional slide projectors and screens.

Portable Storage Unit

With continued reference to FIGS. 7 and 8 and addition reference to FIGS. **15** and **16**, the data storage and control unit **300** of the invention is illustrated as a portable storage unit **392**. In this embodiment of the portable storage unit **392**, the data storage and control unit 300 is utilized in conjunction with a remote origination device, such as a digital camera 394 as shown in FIG. **17**. The digital camera **394** may include one or more data outputs, such as a memory card port **396**, a wireless transmitter **398**, or a data port **400**, which are discussed below.

Exemplary portable storage unit **392** includes the housing **314** in which the processor **302** and the memory **360** are received on a circuit board 368. Like the play-back unit **386**, the storage **312** of the portable storage unit **392** may include the hard disk 362. For the data input **304**, exemplary storage unit **392** may include the memory card port **320**, the data port **324**, and the wireless port **328**. In this embodiment, the memory card port 320 may also function as a data output, which is discussed below. The data output 306 of exemplary portable storage unit **392** may include at least one video port **354** configured to industry standards. The audio port **350** may also be included.

The power supply **316** of exemplary portable data storage unit 392 preferably includes the

battery 340 which may be recharged via the charge socket 372. Alternatively, the battery 340 may be recharged via the optional DC or AC input 342 or 344. The switch 346 and the indicator light 370 may also be provided. Substantially analogous to the embodiments described above, the manual input 336 of exemplary portable storage unit 392 may include a plurality of navigation buttons 374.

Exemplary portable storage unit 392 may also include the data display 318. More specifically, the portable storage unit 392 may include the text display 356, which is shown as an LCD panel 406 in FIG. 15. Alternatively, the data display 318 may include an LCD display capable of displaying image data (as well as text data), such as those common on hand-held televisions. The user may utilize the LCD panel 406 in entering text data corresponding to image data or in reading such data. In this regard, the manual input 336 may include a small keypad for entering text.

In use with a digital camera, the data port 324 of the data input 304 may be connected to the data port 400 of the digital camera 394 with a cable 402 as shown in FIG. 17. Digitize images from the camera 394 may then be transmitted to the portable storage unit 392 via the cable 402. Alternatively, digitized images from the camera 394 may be transmitted wirelessly from the transmitter 398 thereof to the wireless port 328 of the data input 304 of exemplary portable storage device 392. The wireless port 328 may include an antenna 404 for enhancing the reception of data, which antenna may be retractable as shown in FIG. 15.

When received, the data may be stored on board the unit 392 on the memory 360 or on the optional hard drive 362. Alternatively, the received data may be provided directly to a memory card received in the memory card port 320 of the storage unit 392. Still alternatively, the camera 394 may store digitized images on a memory card in the memory card port 396 of the camera, which memory card may then be transferred to the portable storage unit 392 for downloading onto the memory 360 and/or hard drive 362. After downloading, the processor 302 may clear the memory card of data, with user returning the memory card thereafter to the camera 394 to receive additional data.

After utilizing the digital camera-portable storage unit combination in the field, the user may connect on of the data outputs 306 to a personal computer and download data stored in the memory 360 and/or the hard drive 362 onto the computer. Alternatively, the portable storage unit 392 may function in a manner substantially analogous to the play-back unit 386 described above. More specifically, the video port 354 of the data output 306 may be connected to an A/V device, with the

user playing back stored images as described above.

Those skilled in the art will understand the many benefits and advantages of the portable storage unit **392** of the present invention in the field of photography. For example, professional photographers typically carry hundreds of rolls of film into the field on assignment. The film is bulky and susceptible to the elements. By utilizing the digital camera **394** and the portable storage unit **392** of the present invention, this use of bulk film is eliminated. More specifically, the photographer is able to store hundreds of photographs on the memory **360** and/or hard drive **362**, which eliminate the need for film. In addition, the relatively large storage capacity of the hard drive **362** significantly reduces the number of memory card needed on an assignment, which memory cards are expensive. Further, the portable storage device **392** of the invention also eliminates the need of carrying a personal computer into the field, which may digital photographers do to store images.

With regard to the portability of exemplary storage unit **392**, the housing **314** preferably has dimensions that render the unit easy to carry on person, for example, in a shoulder bag, a hip bag, or a pocket. Alternatively, exemplary portable storage unit **392** may include a belt clip **408** for engaging with a belt of a user.

Those skilled in the art will understand that the preceding exemplary embodiments of the present invention provide the foundation for numerous alternatives and modifications thereto. These other modifications are also within the scope of the present invention. Accordingly, the present invention is not limited to that precisely as shown and described above.

CLAIMS

What is claimed is:

1. A portable data storage and control unit, comprising:

a data input for receiving data;

a data output for providing data;

a control input for providing a control signal;

a storage device for storing data; and

a processor connected to said data input, said data output, said control input, and said storage device, said processor being configured to:

cause data received at said data input to be stored on said storage device; and

cause data stored on said storage device to be provided to said data output upon receipt of said control signal from said control input.

2. A portable data storage and control unit as claimed in claim 1 further comprising a housing in which said processor and said storage device are received.

3. A portable data storage and control unit as claimed in claim 2 wherein each of said inputs and said output is disposed on said housing.

4. A portable data storage and control unit as claimed in claim 2 wherein said housing has a volume of less than about 40 cubic inches.

5. A portable data storage and control unit as claimed in claim 1 further comprising a power supply connected to said processor.

6. A portable data storage and control unit as claimed in claim 5 wherein said power supply comprises a battery.

7. A portable data storage and control unit as claimed in claim 5 wherein said power supply comprises a power input.

8. A portable data storage and control unit as claimed in claim 5 further comprising a switch for activating said power supply.

9. A portable data storage and control unit as claimed in claim 1 further comprising a data display connected to said processor.

10. A portable data storage and control unit as claimed in claim 9 wherein said data display comprises an information screen for displaying text.

11. A portable data storage and control unit as claimed in claim 9 wherein said data display comprises a display screen for displaying images.

12. A portable data storage and control unit as claimed in claim 1 wherein said storage device comprises a memory.

13. A portable data storage and control unit as claimed in claim 1 wherein said storage device comprises a hard drive.

14. A portable data storage and control unit as claimed in claim 1 wherein said data input comprises a memory card port for receiving a memory card.

15. A portable data storage and control unit as claimed in claim 14 further comprising a controller connected between said memory card port and said processor.

16. A portable data storage and control unit as claimed in claim 1 wherein said data input comprises a data port connectable to a communication medium.

17. A portable data storage and control unit as claimed in claim 16 further comprising a buffer connected to said data port for temporarily storing data received at said data port.

18. A portable data storage and control unit as claimed in claim 1 wherein said data input

comprises a wireless input for receiving data transmitted wirelessly.

19. A portable data storage and control unit as claimed in claim 18 further comprising a buffer connected to said wireless port for temporarily storing data received at said wireless port.

20. A portable data storage and control unit as claimed in claim 1 wherein said data input comprises a video port.

21. A portable data storage and control unit as claimed in claim 20 further comprising a controller connected between said video port and said processor.

22. A portable data storage and control unit as claimed in claim 1 wherein said control input comprises a manual input for manual activation by a user to generate said control signal.

23. A portable data storage and control unit as claimed in claim 22 wherein said manual input comprises navigation buttons.

24. A portable data storage and control unit as claimed in claim 1 wherein said control input comprises a remote input for receiving said control signal wirelessly from a user.

25. A portable data storage and control unit as claimed in claim 24 further comprising a remote control for activating said remote input wirelessly upon activation by a user.

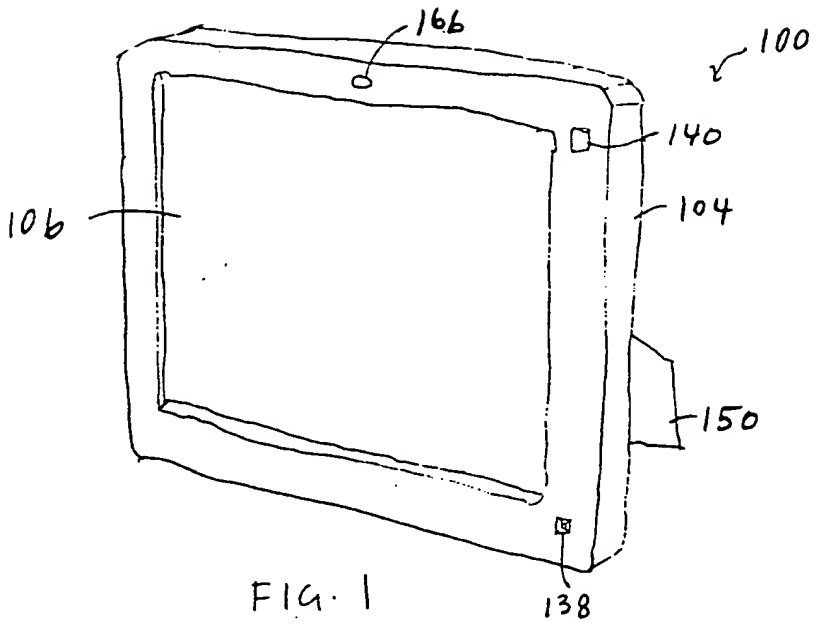
166
100
140
106
104
150
138

FIG. 1

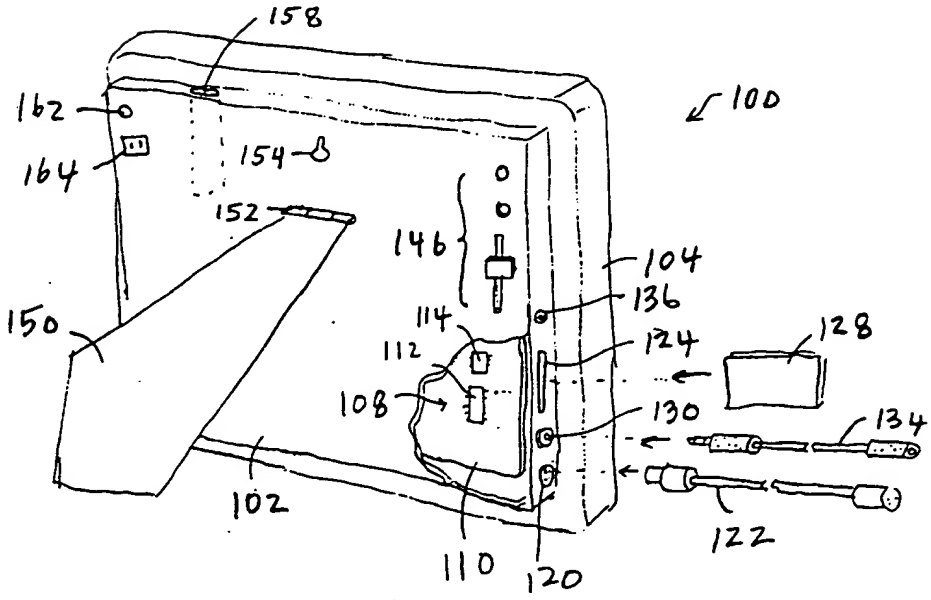
158
100
162
164
154
152
146
104
136
150
114
112
124
128
108
130
134
102
122
110
120

FIG. 2

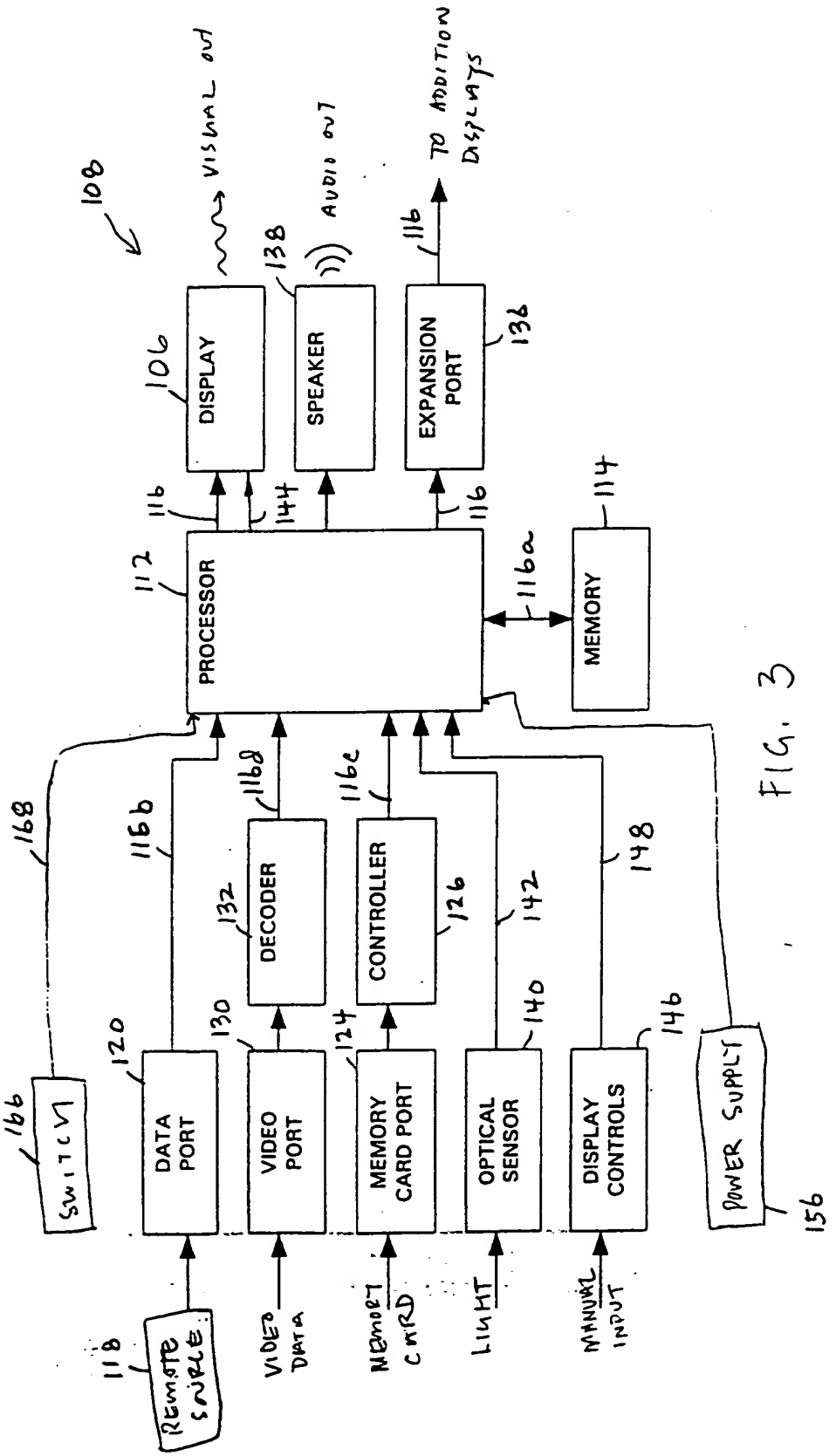
108
VISUAL OUT
AUDIO OUT
TO ADDITION DISPLAYS
DISPLAY
SPEAKER
EXPANSION PORT
106
138
116
144
PROCESSOR
112
116a
MEMORY
114
168
166
SWITCH
116b
116d
116c
DECODER
CONTROLLER
132
126
142
148
120
130
124
140
146
DATA PORT
VIDEO PORT
MEMORY CARD PORT
OPTICAL SENSOR
DISPLAY CONTROLS
POWER SUPPLY
156
118
REMOTE SIGNALS
VIDEO DATA
MEMORY CARD
LIGHT
MANUAL INPUT

FIG. 3

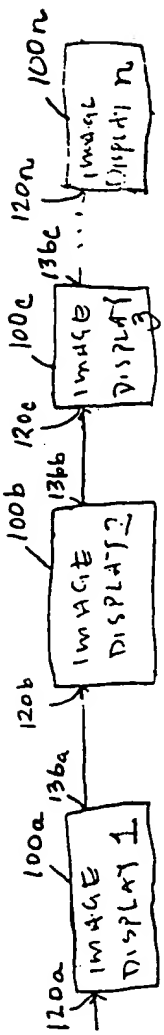
100a
IMAGE DISPLAY 1
120a
136a
100b
IMAGE DISPLAY 2
120b
136b
100c
IMAGE DISPLAY 3
120c
136c
100n
IMAGE DISPLAY n
120n

FIG. 4

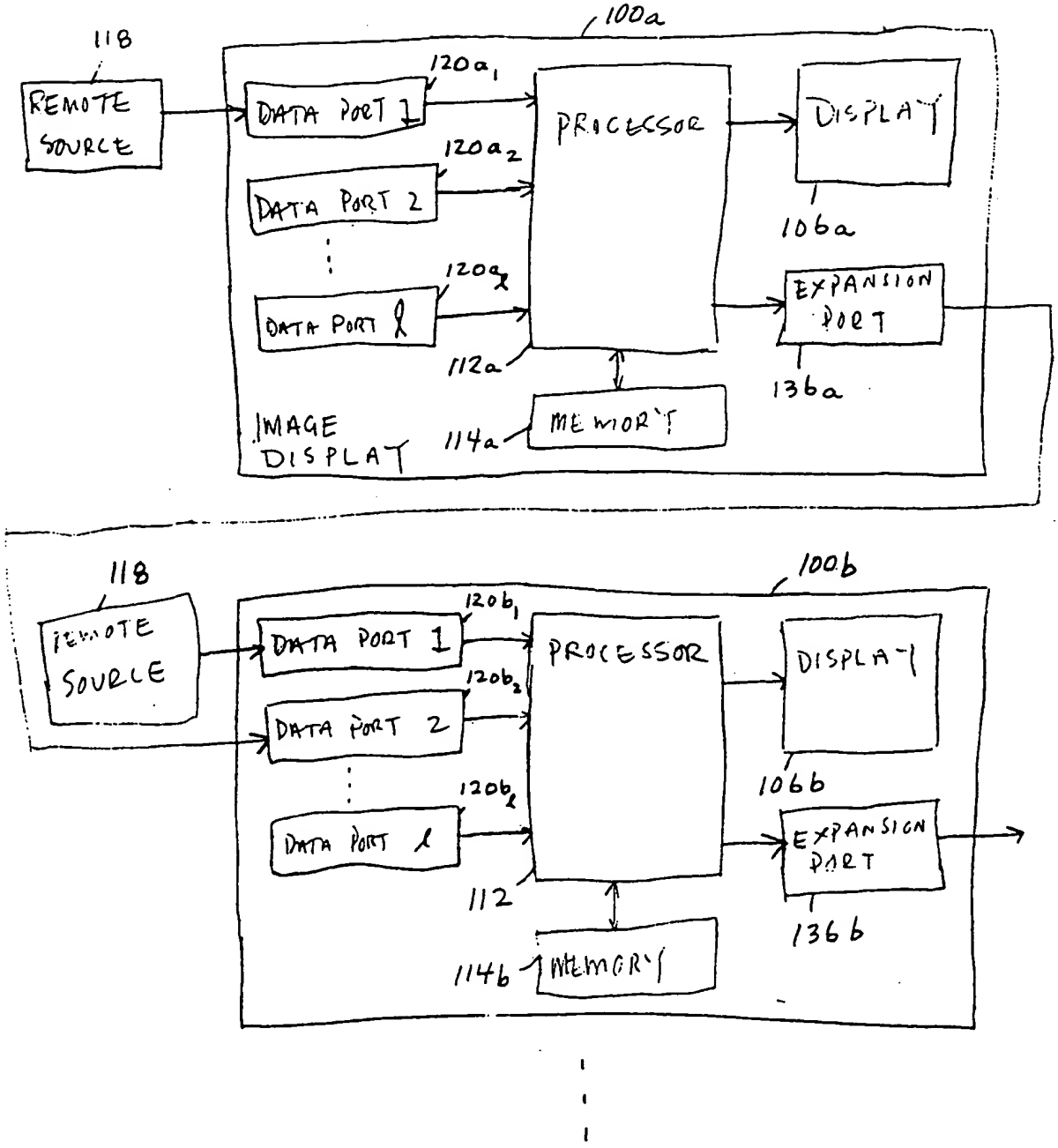
100a
118
REMOTE SOURCE
DATA PORT 1
120a1
DATA PORT 2
120a2
DATA PORT l
120al
PROCESSOR
DISPLAY
106a
EXPANSION PORT
136a
112a
MEMORY
114a
IMAGE DISPLAY
100b
118
REMOTE SOURCE
DATA PORT 1
120b1
DATA PORT 2
120b2
DATA PORT l
120bl
PROCESSOR
DISPLAY
106b
EXPANSION PART
136b
112
MEMORY
114b

FIG. 5

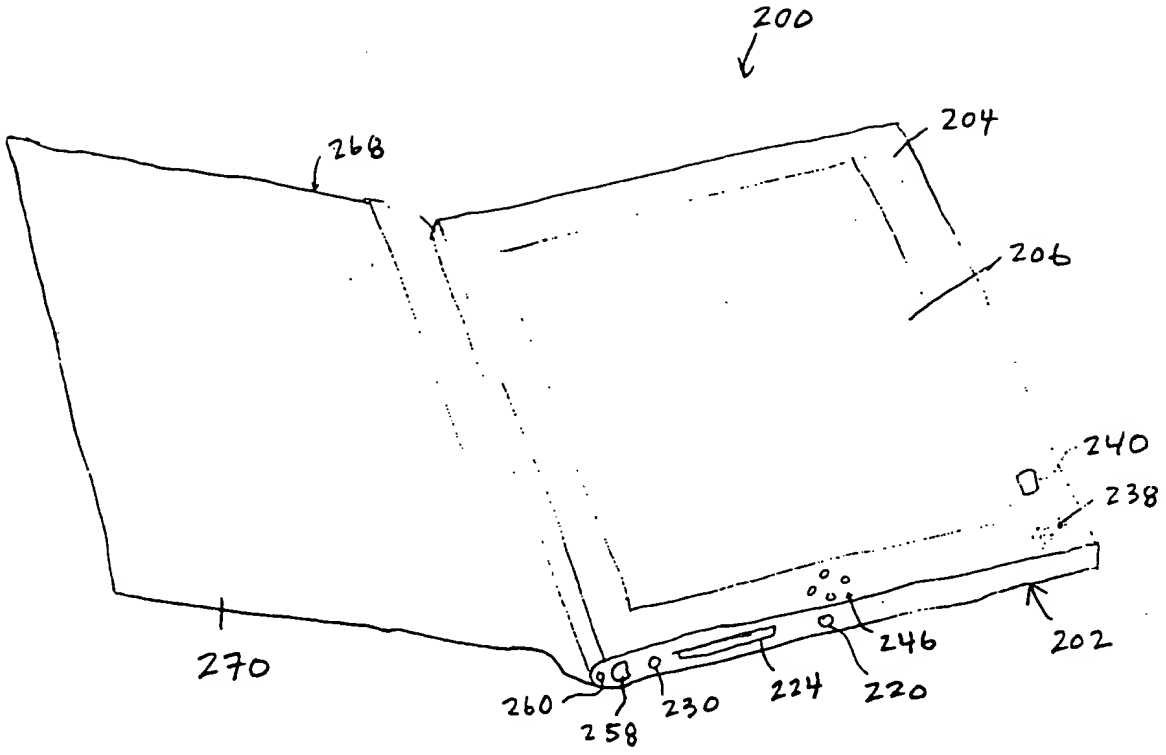

Fig. 6

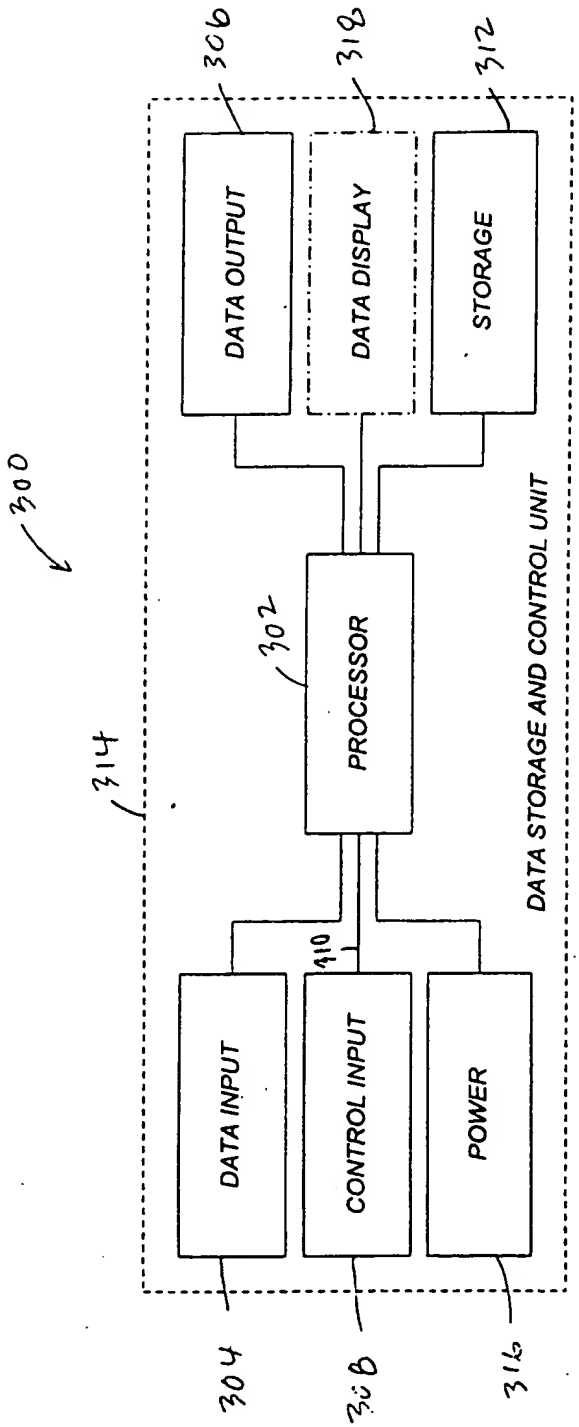
300
314
306
318
312
DATA OUTPUT
DATA DISPLAY
STORAGE
302
PROCESSOR
DATA STORAGE AND CONTROL UNIT
410
DATA INPUT
CONTROL INPUT
POWER
304
308
316

FIG. 7

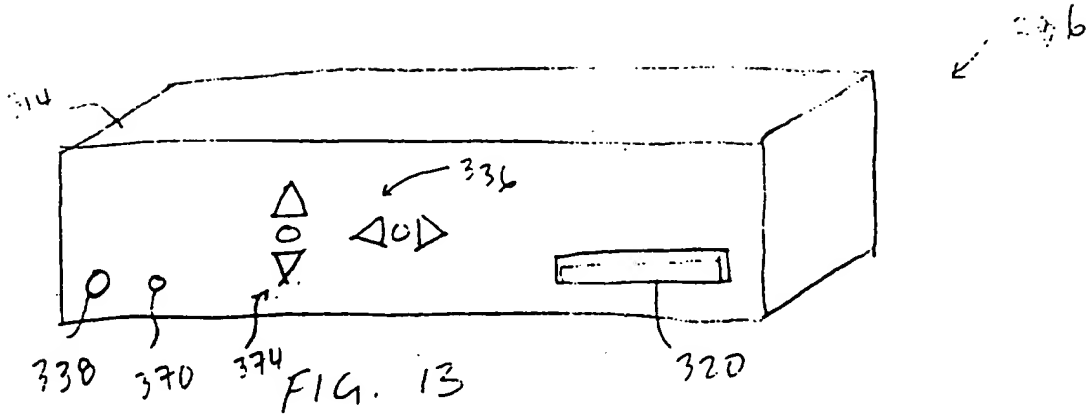
336
338
370
374
320

FIG. 13

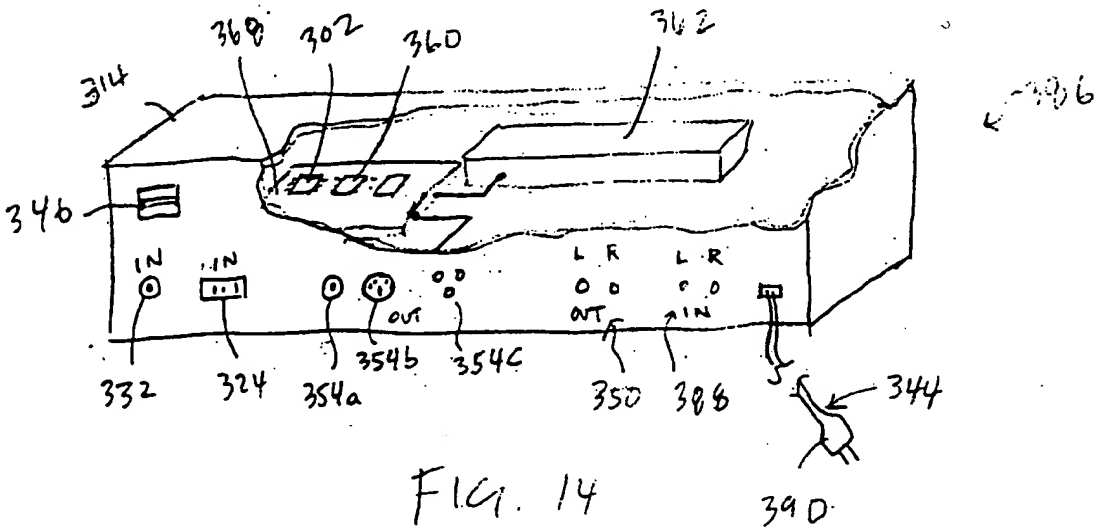
368
302
360
362
314
346
IN
IN
OUT
L R
L R
ANT
IN
332
324
354a
354b
354c
350
388
344
390

FIG. 14

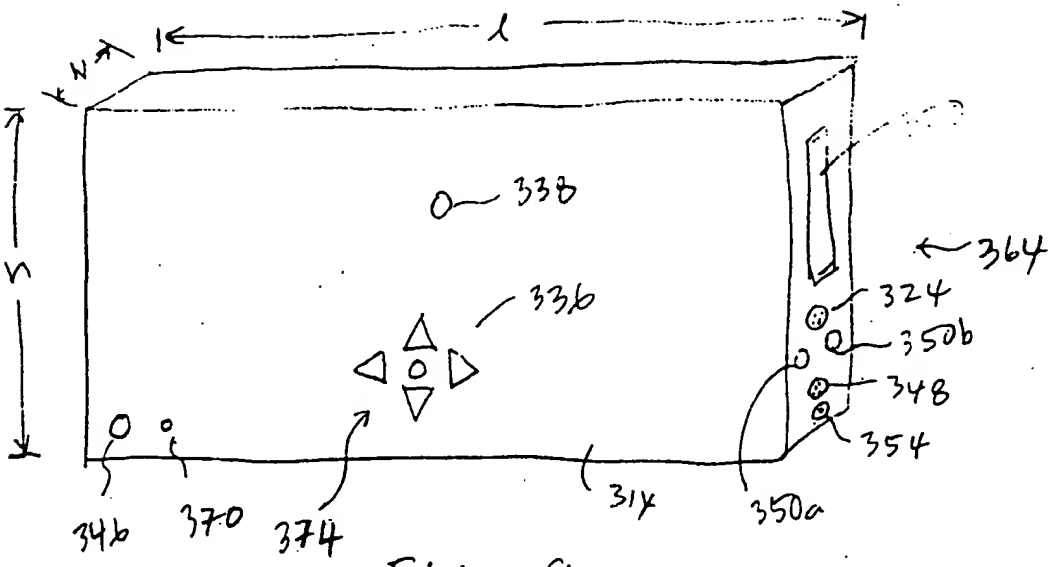

FIG. 9

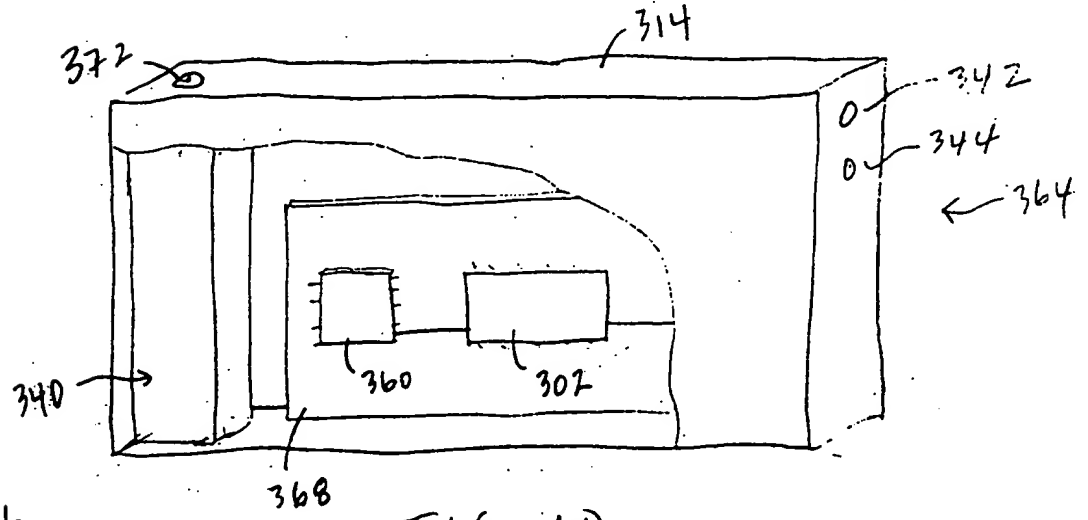

FIG. 10

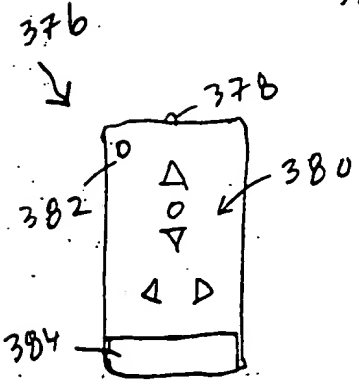

FIG. 12

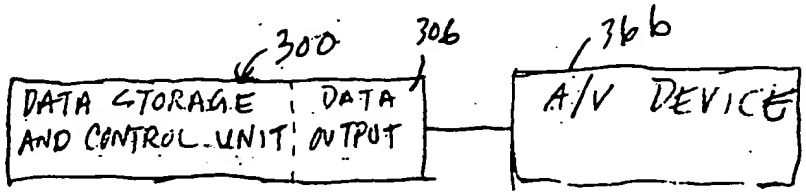

FIG. 11

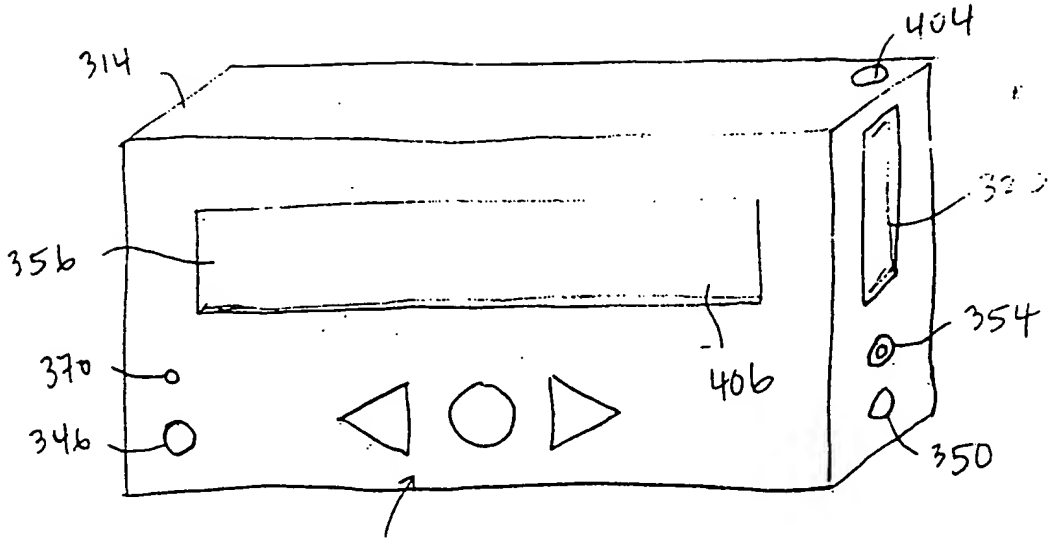

FIG. 15

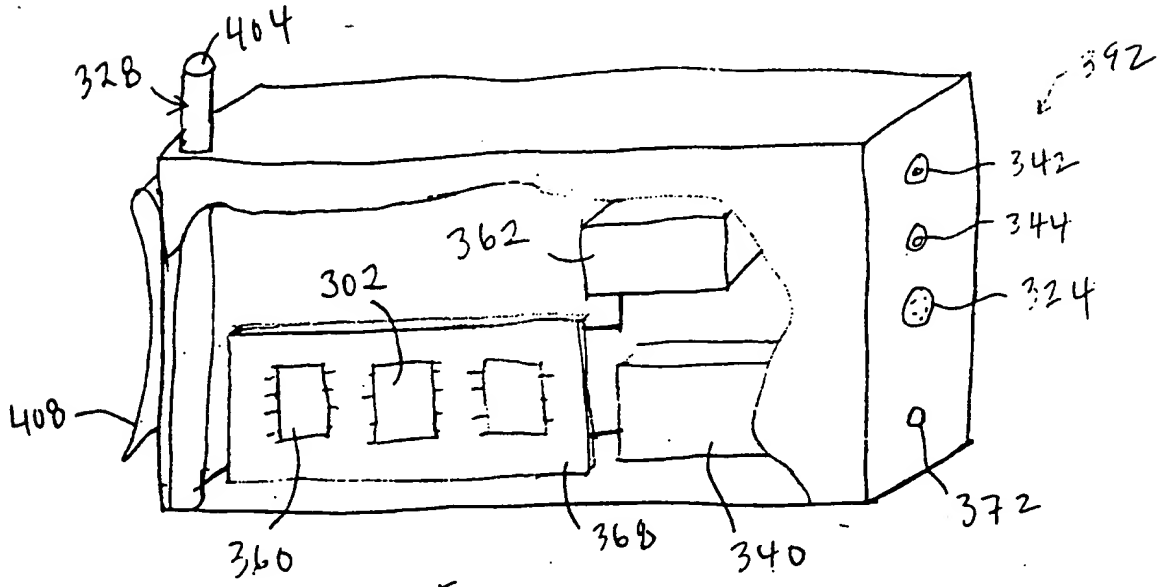

FIG. 16

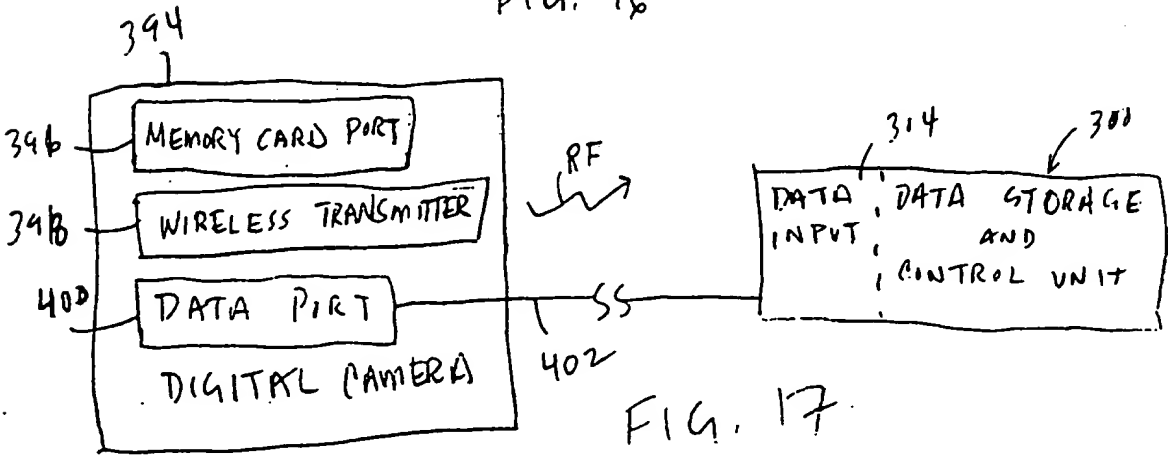

FIG. 17